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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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10/688,231

10/17/2003

Muhammed Ayman Shibib

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12/20/2004

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EXAMINER

ECKERT II, GEORGE C

ART UNIT

PAPER NUMBER

2815

DATE MAILED: 12/20/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

10/688,231

Applicant(s)

SHIBIB ET AL.

Examiner

George C. Eckert II

Art Unit

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 03 December 2004.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-25 is/are pending in the application.
- 4a) Of the above claim(s) 17-21 is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-7, 10-16 and 22-25 is/are rejected.
- 7) ☒ Claim(s) 8 and 9 is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 09 December 2003 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. _____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☒ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date 2/2/04.
- 4) ☐ Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: _____

DETAILED ACTION

Election/Restrictions

1. Applicant's election with traverse of the group I invention (claims 1-16 and 22-25) in the reply filed on December 3, 2004 is acknowledged. The traversal is on the ground that the apparatus of the group I invention and the method of the group II invention are of such similar character as to eliminate the necessity for a separate search and/or classification. This is not found persuasive because, as made clear in the restriction requirement, the apparatus and method of the different inventive groups, *have* acquired separate status in the art as evidenced by their separate classification. Moreover, merely because there may be overlap between a search for the device and a search for the method of making the device does not mean that there is not a burden in examining the separate inventions. Rather, the separate status in the art of the two inventions indicates that a burden exists. The requirement is still deemed proper and is therefore made FINAL. Claims 17-21 are withdrawn from further consideration pursuant to 37 CFR 1.142(b), as being drawn to a nonelected invention, there being no allowable generic or linking claim.

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

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2. Claims 1-3, 7, 10-12, 14, 22 and 23 are rejected under 35 U.S.C. 102(e) as being anticipated by 6,548,863 to Patti. Regarding claims 1, 10, 11 and 22, Patti teaches in figure 1 an LDMOS device comprising:

a semiconductor layer comprising a substrate 4 of a first conductivity type (p-type) and a second layer 5 of second conductivity type (n-type) formed on the substrate;

a first source/drain region 10 of the second conductivity type formed in the second layer 5 proximate an upper surface of the second layer;

a second source/drain region 12 of the second conductivity type formed in the second layer proximate the upper surface of the second layer and spaced laterally from the first source/drain region;

a gate 18 formed above the second layer proximate the upper surface of the second layer and at least partially between the first and second source/drain regions; and

at least one electrically conductive trench 16 formed in the second layer between the gate 18 and the second source/drain region 12, the at least one trench being formed proximate the upper surface of the semiconductor layer and extending substantially vertically through the second layer to the substrate 2 (see fig. 2, showing the trench 16 extending as claimed).

Regarding claim 2, Patti teaches that the second layer 5 is an epitaxial layer (col. 2, line 23). Regarding claims 3 and 23, because Patti teaches the structure as instantly claimed in claims 1 and 22, the functional language of claims 3 and 23 is considered also achieved by the device of Patti. Regarding claim 7, Patti teaches that the trench 16 is filled with an electrically conductive material (col. 2, lines 62-67). Regarding claim 12, Patti teaches that the first source/drain region 10 comprises a source and the second comprises a drain (col. 2, lines 36-37).

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Regarding claim 14, Patti teaches that the trench 16 is a doped region which anticipates the processing language of “diffused” sinker.

3. Claims 1-4, 7, 10-12, 14-16 and 22-24 are rejected under 35 U.S.C. 102(e) as being anticipated by 2004/00222461 to Peyre-Lavigne et al. (hereinafter “Lavigne”). Regarding claims 1, 2, 4, 10, 11 and 22, Lavigne teaches in figure 6 an LDMOS device comprising:

a semiconductor layer comprising a substrate 66 of a first conductivity type (p-type) and an epitaxial second layer 12 of second conductivity type (n-type) formed on the substrate (see para. 0032);

a first source/drain region 4 of the second conductivity type formed in the second layer 12 proximate an upper surface of the second layer;

a second source/drain region 8 of the second conductivity type formed in the second layer proximate the upper surface of the second layer and spaced laterally from the first source/drain region;

a gate 6 formed above the second layer proximate the upper surface of the second layer and at least partially between the first and second source/drain regions; and

a plurality of electrically conductive trenches 62 formed in the second layer between the gate 6 and the second source/drain region 8, the trenches being formed proximate the upper surface of the semiconductor layer and extending substantially vertically through the second layer to the substrate 66 (see fig. 6, showing the trench 62 including the dashed lines extending as claimed, see para. 0030).

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Regarding claims 3, 4, 15, 23 and 24, because Lavigne teaches the structure as instantly claimed in claims 1 and 22, the functional language of claims 3, 4, 15, 23 and 24 is considered also achieved by the device of Lavigne; moreover, Lavigne teaches in paragraph 0024 that the conductive trenches form a junction which reduces the electric field and thus reduces hot carriers. Regarding claim 7, Lavigne teaches that the trenches 62 are filled with an electrically conductive material (para. 0033). Regarding claim 12, Lavigne teaches that the first source/drain region 4 comprises a source and the second comprises a drain (as labeled in fig. 6). Regarding claim 14, Lavigne teaches that the trench 66 is a doped region which anticipates the processing language of "diffused" sinker. Regarding claim 16, Lavigne teaches that the trenches are spaced substantially uniformly between the gate and drain (see fig. 6 and para. 0023).

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

4. Claim 13 is rejected under 35 U.S.C. 103(a) as being unpatentable over Lavigne in view of 6,787,872 to Kinzer et al. Lavigne taught the device of claim 1 but did not expressly teach that the trench comprised a v-groove. Kinzer teaches that a trench may be formed having any of several varying shapes (note Kinzer teaches that the trenches may have varying lengths, widths and depths).

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Lavigne and Kinzer are combinable because they are from the same field of endeavor. At the time of the invention it would have been obvious to a person of ordinary skill in the art to form the device of Lavigne having a v-groove shaped trench. The motivation for doing so, as is taught by Kinzer, is that any length, width or depth may be chosen to obtain the desired RESURF characteristics (col. 2, lines 40-49). Therefore, it would have been obvious to combine Lavigne and Kinzer to obtain the invention of claim 13.

5. Claims 5, 6 and 25 are rejected under 35 U.S.C. 103(a) as being unpatentable over either of Patti or Lavigne as applied above in view of 5,918,137 to Ng et al. Both Patti and Lavigne taught the device of claims 1 and 22 but did not further teach a shielding structure formed proximate the upper surface of the semiconductor layer between the gate and drain, connected to the source region, laterally spaced from and non-overlapping with the gate. Ng teaches such a shielding structure 40 in figure 1E. Ng further teaches that the shielding structure is grounded (col. 2, lines 1-3) and thus electrically connected to the source region which is also inherently grounded.

Either of Patti or Lavigne is combinable with Ng because they are from the same field of endeavor. At the time of the invention it would have been obvious to a person of ordinary skill in the art to form the device of Patti or Lavigne using the shielding structure of Ng. The motivation for doing so, as is taught by Ng, is that such shield reduces the gate to drain feedback capacitance without increasing the input capacitance of the device (col. 1, lines 49-51). Therefore, it would have been obvious to combine either Patti or Lavigne and Ng to obtain the invention of claims 5, 6 and 25.

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Allowable Subject Matter

6. Claims 8 and 9 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.


Conclusion

7. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. The additional art teaches various LDMOS devices having trenches between the gate and drain.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to George C. Eckert II whose telephone number is (571) 272-1728.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Tom Thomas can be reached on (571) 272-1664. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).


GEORGE ECKERT
PRIMARY EXAMINER